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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/088,975	08/13/2002	Thomas L Ritzdorf	SEMT118781	6706
26389	7590	11/30/2005	EXAMINER	
CHRISTENSEN, O'CONNOR, JOHNSON, KINDNESS, PLLC 1420 FIFTH AVENUE SUITE 2800 SEATTLE, WA 98101-2347			LEADER, WILLIAM T	
			ART UNIT	PAPER NUMBER
			1742	

DATE MAILED: 11/30/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/088,975	Applicant(s) RITZDORF ET AL.	
	Examiner William T. Leader	Art Unit 1742	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 September 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-22,24-26 and 28-32 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-22,24-26 and 28-32 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on September 16, 2005, has been entered.

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1, 3-5, 8, 13-16, 18, 20, 22, 24-26 and 28-32 are rejected under 35 U.S.C. 102(e) as being anticipated by Dubin et al (5,972,192).

5. The Dubin et al patent is directed to a process for filling high aspect ratio openings such as via holes or trenches in a dielectric layer with metal to obtain high conductivity interconnect

structures on a semiconductor. Via holes and trenches are structures which have sidewalls, bottom surfaces and openings opposite the bottom surfaces. The metal may be copper and may be deposited by forward-reverse pulse electroplating. Such a process is set forth in example 2. Dubin et al teach that the electroplating composition may comprise copper sulfate to supply Cu^{2+} ions, Cl^- anions, sulfuric acid, a leveling agent and a brightening agent (column 7, line 58 - column 8, line 3). Instant claim 1 recites the step of supplying net forward electroplating power. The expression "forward" is considered to denote a direction of current flow such that electrodeposition takes place on the workpiece. The expression "net forward electroplating power" is interpreted to include any type of electric waveform in which the net effect is the application of forward electroplating power. This expression is considered to include electroplating waveforms in which forward electroplating power alternates with reverse electroplating power as long as the net effect is the electrodeposition of material onto the workpiece. (More specifically, the expression is considered to denote the net application of charge as measured in coulombs of a polarity which causes electrodeposition.) Example 2 of Dubin et al meets the limitations of step (b) of instant claim 1

6. Step (c) of claim 1 recites reversing the electroplating power supplied between the anode and the surface of the workpiece for at least a portion of a second time period. Claim 3 recites that during the second time period the power is alternated between pulses of forward power interspersed with pulses of reverse power. The forward-reverse pulse current supplied in example 2 of Dubin et al meets this limitation. In example 2 of Dubin et al, the time period during which the forward-reverse pulse current is applied to nominally fill the trenches may be

considered a first time period as recited in claim 1, step (b). The remainder of the time during which current is applied in example 2 may be considered a second time period as recited in claim 1, step (c). Claims 24-28 include similar limitations. Thus, Dubin et al meets the limitations of independent claims 1, 24, 25, 26 and 28.

7. With respect to claim 3, Dubin et al disclose electroplating power which is alternated between pulses of forward power interspersed with pulses of reverse power as noted above. With respect to claims 4 and 5, in example 2 of Dubin et al anodic (reverse) pulse duration is about 0.1 to about 10 msec. Claim 8 recites a third time period when forward and reverse power is supplied in a series of interspersed pulses. As noted above, Dubin et al disclose electroplating power which is alternated between pulses of forward power interspersed with pulses of reverse power. A period during which the current of Dubin et al is applied may be considered a first time period, while a different period may be considered a third time period. With respect to claims 13-15, Dubin et al discloses the use of a copper plating bath contain chloride ions and using copper sulfate as a source of copper as noted above. With respect claims 16, 18 and 21, Dubin et al disclose the use of organic additives including brighteners and levelers. It is recognized in the art that brighteners act as accelerators while levelers act as suppressors. (See, for example, Horkans et al 6,592,747 which notes that "other commons names for the suppressor are polarizer or leveler" and "other common names for the accelerator are depolarizer or brightener" at column 2, lines 38-47; or Tsai et al 6,224,737 which includes a similar disclosure at column 1, lines 33-48). With respect to claim 22, a forward pulse of Dubin et al is forward electroplating power. With respect to claim 32, Dubin et al teach that continuous seed layer is

needed to carry electrical current. In copending application 08/857,129, now patent 5,969,422, a seed layer comprising an alloy of a refractory metal is initially deposited. See column 4, lines 19-30. Deposition would have occurred over the entire seed layer, meeting the limitations of claim 32.

8. The apparatus of Dubin et al corresponds to the apparatus recited in claims 28-31 and is capable of carrying out the functions recited in claims 29-31. The manner of operating a device does not differentiate apparatus claims from the prior art. See MPEP 2114.

9. Claims 28-32 are rejected under 35 U.S.C. 102(b) as being anticipated by Anthony (4,396,467) for the reasons given in the previous office action.

10. Applicant's Remarks have been carefully considered. However, as noted above, the manner of operating a device does not differentiate apparatus claims the prior art. MPEP 2114. Additionally, the material worked on by an apparatus does not limit apparatus claims. See MPEP 2115.

Claim Rejections - 35 USC § 103

11. Claims 6, 7, 9-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin et al (5,972,192).

12. The Dubin et al patent is interpreted and applied as above. Dubin et al state that "In employing pulse electroplating in accordance with the present invention, one having ordinary skill in the art could easily optimize the relevant variables, such as the duty cycle, frequency and current density in a particular situation (column 5, lines 63-67). In view of this teaching, choice

of operating parameters would have been a matter of routine optimization within the skill of the ordinary worker in the art.

13. Claims 16-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin et al (5,972,192) in view of Sonnenberg et al (5,223,118) and Creutz (3,770,598).

14. The Dubin et al patent is interpreted and applied as above. Dubin et al state that "Leveling agents are well known and, hence need not be employed herein in great detail" (column 6, lines 15-16) and "As brightening agents are conventional, they are not discussed herein in great detail" (column 7, lines 19-20). The Sonnenberg et al patent and the Creutz patent are taken as in the previous office action to show that the classes additives recited in instant claims 16, 18 and 20, and the specific additives recited in instant claim 17, 19 and 21 are conventionally used to improve copper deposits. It would have been obvious at the time the invention was made to have utilized the specific additives disclosed by Sonnenberg et al and Creutz in the additives in the copper plating bath of Dubin et al because the properties of the deposit would have been improved.

15. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin et al (5,972,192) in view of Ting et al (5,969,422).

16. If Dubin et al is not considered to teach that deposition takes place on the surface and within the recessed microstructures, reference is made to the Ting et al patent, referred to at

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column 4, lines 25-26 of Dubin et al. Ting et al show that deposition takes place on the surface as well as within the microstructures. See figures 1-3.

17. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Horkans et al (6,592,747) discloses properties and nomenclature of electroplating additives useful in copper plating baths. Suppressors, also known as polarizers or levelers, slow down copper deposition. Accelerators, also known as depolarizers or brighteners, increase the rate of copper deposition. See column 2, lines 38-47). Tsai et al (6,224,737) also discloses additives for copper electroplating baths, and teaches that suppressors are also known as carriers or levelers. Brighteners locally accelerating deposition rates (column 1, lines 33-47).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to William T. Leader whose telephone number is 571-272-1245. The examiner can normally be reached on Mondays-Thursdays and alternate Fridays, 7:30-4:00.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy King, can be reached on 571-272-1244. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

WL

William Leader
November 22, 2005

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